



**EA-12-049**  
**10 CFR 50.54(f)**

**Maria L. Lacal**  
Senior Vice President, Nuclear  
Regulatory & Oversight

**Palo Verde**  
**Nuclear Generating Station**  
P.O. Box 52034  
Phoenix, AZ 85072  
Mail Station 7605  
**Tel 623.393.6491**

102-07388-MLL/MDD  
December 8, 2016

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555

- References:
1. NRC Letter, *Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident*, dated March 12, 2012 [Agencywide Documents Access and Management System (ADAMS) Accession No. ML12056A046]
  2. NRC Letter, *Palo Verde Nuclear Generating Station, Units 1, 2, and 3 – Correction to Interim Staff Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation*, dated October 8, 2015 (ADAMS Accession Number ML15280A022)
  3. NRC Letter, *Palo Verde Nuclear Generating Station, Units 1, 2, and 3 – Staff Assessment of Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation*, dated November 14, 2016 (ADAMS Accession No. ML ML16306A444)
  4. APS Letter 102-07159, *APS Final Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design Basis External Events (Order Number EA-12-049)*, dated December 24, 2015 (ADAMS Accession No. ML 15364A034)

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**  
**Units 1, 2, and 3**  
**Docket Nos. STN 50-528, 50-529, and 50-530**  
**Mitigating Strategies Assessment (MSA) Report Submittal**

On March 12, 2012, the NRC issued Reference 1 to request information associated with Near-Term Task Force (NTTF) Recommendation 2.1 for Flooding. One of the Required Responses in Reference 1 directed licensees to submit a *Flood Hazard Reevaluation Report* (FHRR).

In Reference 2, dated October 8, 2015, the NRC staff concluded the Arizona Public Service Company (APS) provided FHRR was suitable for the assessment of mitigating strategies in response to Order EA-12-049. Reference 2 also included a Table 2 that provided the Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2 and 3, flood elevations to be considered in performing a mitigating strategies assessment (MSA)

with respect to the local intense precipitation (LIP) reevaluated flood hazard, which is the sole reevaluated flood-causing mechanism that was not explicitly bounded by the PVNGS current licensing basis.

In Note 1 of Table 2, the NRC staff indicated that APS was expected to develop flood event duration (FED) parameters and applicable flood associated effects (AEs) to conduct the MSA consistent with industry guidance.

In Reference 3, dated November 14, 2016, the NRC staff documented the completion of their evaluation of the APS provided FHRR and reiterated that APS was to perform an MSA with respect to the LIP reevaluated flood hazard.

The enclosure to this letter contains the APS MSA for flooding which includes the requested FED parameters and applicable flood AEs that were used in the MSA.

The MSA concludes that the current FLEX strategies can be deployed as designed and submitted in the PVNGS Final Integrated Plan, Reference 4 dated December 24, 2015.

No commitments are being made in this letter. Should you need further information regarding this response, please contact Michael D. DiLorenzo, Licensing Section Leader, at (623) 393-3495.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on December 8, 2016  
(Date)

Sincerely,

Enclosure: Mitigating Strategies Assessment (MSA) for Flooding

MLL/MDD/af

cc:	K. M. Kennedy	NRC Region IV Regional Administrator
	S. P. Lingam	NRC NRR Project Manager for PVNGS
	M. M. Watford	NRC NRR Project Manager
	C. A. Peabody	NRC Senior Resident Inspector for PVNGS

**Enclosure**

**Mitigating Strategies Assessment (MSA) for  
Flooding**

## Mitigating Strategies Assessment (MSA) for Flooding

On March 12, 2012, the NRC issued Reference 1 and 8 to request information associated with Near-Term Task Force (NTTF) Recommendation 2.1 for Flooding. One of the required responses in Reference 1 directed licensees to submit a *Flood Hazard Reevaluation Report* (FHRR). For Palo Verde Nuclear Generating Station (PVNGS), the FHRR was submitted on December 12, 2014 (Reference 2). Reference 7, documented that the NRC staff considers the reevaluated flood hazard to be “beyond the current design/licensing basis of operating plants.”

Concurrent with the development of the flood hazard reevaluation, APS developed and implemented mitigating strategies in accordance with NRC Order EA-12-049, *Requirements for Mitigation Strategies for Beyond-Design-Basis External Events*. In Reference 3, the Commission affirmed that licensees need to address the reevaluated flooding hazards within their mitigating strategies for beyond design basis (BDB) external events, including the reevaluated flood hazards.

Guidance for performing mitigating strategies assessments (MSAs) is contained in Appendix G of Reference 4, endorsed by the NRC (with conditions) in Reference 5. For the purpose of the MSAs, the NRC has termed the reevaluated flood hazard, summarized in References 6 and 7, as the *Mitigating Strategies Flood Hazard Information* (MSFHI). Reference 4, Appendix G, describes the MSA for flooding as containing the following elements:

- Section G.2 – Characterization of the MSFHI
- Section G.3 – Comparison of the MSFHI and FLEX Design Basis (DB) Flood
- Section G.4.1 – Assessment of Current FLEX Strategies (if necessary)
- Section G.4.2 – Assessment for Modifying FLEX Strategies (if necessary)
- Section G.4.3 – Assessment of Alternative Mitigating Strategies (if necessary)
- Section G.4.4 – Assessment of Targeted Hazard Mitigating Strategies (if necessary)

The following provides the MSA results for the Palo Verde Nuclear Generating Station, Units 1, 2 and 3.

### Reference 4, Section G.2 – Characterization of the MSFHI

APS identified no issues associated with flood-causing mechanisms from probable maximum flood (PMF) on the East or Winters washes, or local intense precipitation (LIP) for PVNGS Units 1, 2 and 3. Other mechanisms such as dam failure, storm surge, seiche, tsunami, ice-induced flooding, and channel migration diversions have no impact on the site (References 6 and 7).

In Reference 6, the NRC concluded that the “reevaluated flood hazards information (i.e. MSFHI), as summarized in the Enclosure (Summary Table 2 of the Reevaluated Flood Hazard Levels), is suitable for the assessment of mitigating strategies developed in response to Order EA-12-049” for PVNGS.

### Reference 4, Section G.3 – Comparison of the MSFHI and FLEX DB Flood

The PVNGS current licensing basis states that the site is considered a “Dry Site” (Reference Updated Final Safety Analysis Report (UFSAR) section 1.8, response to Regulatory Guide 1.102). It continues in UFSAR section 2.4.3 stating in part, “Areas adjacent to the power block are sloped away at 0.5 to 1%. This results in a minimum drop of 5 to 7 feet at the peripheral drainage system, as compared to the grade elevation at each unit.” And, “[t]he volume of water in the vicinity of the power block area consequent to a 6-hour PMP is based on zero infiltration losses and a complete blockage of the drainage culverts for the storm

## Mitigating Strategies Assessment (MSA) for Flooding

duration.” Table 1 of this enclosure reflects data from the MSFHI for LIP and provides a comparison to the site’s design basis/FLEX design basis flood.

**Table 1 – Local Intense Precipitation**

Flood Scenario Parameter		Plant DB Flood	FLEX Design Basis Flood Hazard	MSFHI	MSFHI Bounded (B) or Not Bounded (NB) by FLEX DB
Flood Level and Associated Effects	1. Max Stillwater Elevation (ft. MSL) - Unit 1 - Unit 2 - Unit 3	None	None	957.7 955.0 952.4	NB (See note 1)
	2. Max Wave Run-up Elevation (ft. MSL)	None	None	(Screened Out)	NB (See note 2)
	3. Max Hydrodynamic/Debris Loading (psf)	Did Not Specify	Same As	Not Applicable (See note 3)	NB (See note 3)
	4. Effects of Sediment Deposition/Erosion	None	Same As	(Screened Out) (See note 4)	B
	5. Other associated effects (identify each effect)	None	Same As	None	B (See note 5)
	6. Concurrent Site Conditions	None	Same As	None	B (See note 6)
	7. Effects on Groundwater	None	Same As	None	B
Flood Event Duration	8. Warning Time (hours)	Not Applicable	Same As	Not Applicable	B (See note 8)
	9. Period of Site Preparation (hours)	None	Same As	None	B
	10. Period of Inundation (hours)	0	Same As	0	B (See note 10)
	11. Period of Recession (hours)	None	Same As	None	B (See note 11)
Other	12. Plant Mode of Operations	No Restrictions	Same As	No Restrictions	B (See note 12)
	13. Other Factors	None	Same As	None	B
<p>Additional notes, ‘Not Applicable’ justification (why a particular parameter is judged not to affect the site), and explanations regarding the bounded/non-bounded determination. Notes correspond to each respective Table line item.</p> <ol style="list-style-type: none"> <li>See Reference 7, Table 4.1-1.</li> <li>Wave run-up flooding was evaluated and screened out (Reference 2 of this enclosure, section 3.2.1.4).</li> <li>Hydrodynamic loading is the maximum load at safety-related structures (Reference 2 of this enclosure, Table 4-4). Debris loading screened out qualitatively based on flow depths, flow velocities, and flow directions predicted by the FLO-2D model for the powerblock area (Reference 2, section 3.2.1.3). This value is not applicable to MSFHI since there are no safety-related structures within the site that are subject to hydraulic loads.</li> <li>Scour due to sediment transport during river flooding was evaluated and screened out (UFSAR Section 2.4.10) (Reference 2, Table 4-4).</li> <li>Flow depths and velocities near safety-related structures were generally small and did not constitute a credible hazard for erosion, sedimentation, or debris loading. Additionally, predicted flow directions were away from safety-related SSCs, which are surrounded by</li> </ol>					

## Mitigating Strategies Assessment (MSA) for Flooding

predominantly paved areas, precluding any impact on the SSCs from sedimentation or debris loading. Therefore, there were no associated effects coinciding with a LIP (Reference 2, section 3.2.1.3).

6. Bounded by Flood Scenario Parameter item 2, Max Wave Run-up Elevation.
7. None.
8. Since effects from flood causing mechanisms will not impact safe shutdown equipment, the plant's capability to achieve cold shutdown will remain the same as the existing design and licensing bases. There is no additional risk due to flooding for an unplanned shut down.
9. None.
10. Power block is not inundated as a result of any flooding event (Reference 2, sections 2 and 3).
11. Rain water runoff will collect in the drainage ditches and will completely recede to lower portions of the site and discharging into the realigned East Wash (Reference UFSAR 2.4.2.2.2). The plants will continue to run safely and be stable throughout the event, and can be maintained indefinitely. The transient ponding effect duration from a LIP reduces to a surface elevation of zero feet at approximately 7 hours (actually or trend towards zero feet). This ponding duration is based on the hydrographs generated for the critical pathways (units 1, 2, and 3 – pathways 10 or 11 through 21) around the safety-related buildings in the powerblock. Within 24 hours into the event, hauling routes will be accessible, allowing equipment to be hauled with existing FLEX vehicles to their designated deployment locations, if FLEX equipment is needed (Reference 10, Figures A-10 through A-20 [Unit 1], A-64 through A-74 [Unit 2] and A-117 through A-123 [Unit 3]).
12. The plants can be in any operating mode during any of these flooding events.
13. None.

### Reference 4, Section G.4 – Evaluation of Mitigating Strategies for the MSFHI

#### Reference 4, Section G.4.1 – Assessment of Current FLEX Strategies

The overall FLEX planned response to an extended loss of AC power (ELAP) and loss of ultimate heat sink (LUHS) will be initiated through normal plant command and control procedures and practices. PVNGS emergency operating procedures (EOPs) and/or abnormal operating procedures (AOPs) govern the operational response. The FLEX strategies will be deployed in support of the EOPs/AOPs using the FLEX Support Guidelines (FSGs), which will provide direction for using FLEX equipment in maintaining or restoring key safety functions. APS pre-deploys specific FLEX equipment, depending on the circumstances during online or outage time durations.

The current FLEX strategies can be deployed as designed as submitted in the Final Integrated Plan (FIP, Reference 9). Ponding of rain water runoff at the peripheral drainage system will have receded sufficiently within 24 hours to allow hauling of equipment with existing FLEX vehicles to their designated deployment locations. The first of this equipment, deploying after 24 hours, will be the 480 VAC generators (Reference FSGs). A minimal amount of accumulation (ponding from rain water runoff) near the facilities is both expected and will not impede the operation of the FLEX equipment. No other applicable flood-causing mechanisms will affect the hauling routes of FLEX equipment.

Flooding events during lower modes of operation are assessed by the shutdown risk assessment when an outage is being planned. Hauling routes, therefore, need not be available at the start of an ELAP/LUHS event when a unit is in an outage. Additionally, the need to start FLEX pumps and generators is not required until 38.5 hours into the event (Reference FSGs).

## Mitigating Strategies Assessment (MSA) for Flooding

### Acronyms:

AOP - Abnormal Operating Procedure  
BDB - Beyond Design Basis  
DB - Design Basis  
ELAP - Extended Loss of AC Power  
EOP - Emergency Operating Procedure  
FHRR - Flood Hazard Reevaluation Report  
FIP - Final Integrated Plan  
FLEX DB - FLEX Design Basis (flood hazard)  
FSG - FLEX Support Guideline  
LIP - Local Intense Precipitation  
LUHS - Loss of Ultimate Heat Sink  
MSA - Mitigating Strategies Assessment  
MSFHI - Mitigating Strategies Flood Hazard Information (from the FHRR and MSFHI letter)  
NTTF - Near-Term Task Force  
PMF - Probable Maximum Flood  
PMP - Probable Maximum Precipitation  
UFSAR - Updated Final Safety Analysis Report

### References:

1. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident; dated March 12, 2012 [Agencywide Documents Access and Management System (ADAMS) Accession Number ML12056A046]
2. Arizona Public Service Company, Letter to USNRC, Response to March 12, 2012 Request for Information Enclosure 2, Recommendation 2.1, Flooding, Required Response 2, Flooding Hazard Reevaluation Report, dated December 12, 2014 (ADAMS Accession Number ML14350A466)
3. NRC Staff Requirements Memoranda to COMSECY-14-0037, *Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards*, dated March 30, 2015
4. Nuclear Energy Institute (NEI), Report NEI 12-06 [Rev 2], *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide*, dated December 2015
5. U.S. Nuclear Regulatory Commission, JLD-ISG-2012-01, Revision 1, *Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-Design-Basis External Events*, dated January 22, 2016 (ADAMS Accession Number ML15357A142)
6. NRC Letter, *Palo Verde Nuclear Generating Station, Units 1, 2, and 3 – Correction to Interim Staff Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation*, dated October 8, 2015 (ADAMS Accession Number ML15280A022)
7. NRC Letter, *Palo Verde Nuclear Generating Station, Unit Nos. 1, 2, and 3 – Staff Response to Reevaluated Flood Hazards Submitted in Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation*, dated November 14, 2016 (ADAMS Accession Number ML16306A444)

## **Mitigating Strategies Assessment (MSA) for Flooding**

8. NRC Letter, *Supplemental Information Related to Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) regarding Flooding Hazard Reevaluations for Recommendation 2.1 of the Near Term Task Force Review of Insights from the Fukushima Dai-ichi Accident*, dated March 1, 2013
9. APS letter number 102-07159, Palo Verde Nuclear Generating Station, *APS Final Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design Basis External Events (Order Number EA-12-049)*, dated December 24, 2015
10. Palo Verde Nuclear Generating Station, Log Number CN396-A00005 (Westinghouse Electric Company/Paul C. Rizzo Associates Calculation 13-5002-F02, Revision 1), *Palo Verde Nuclear Generating Station - Effects of Local Intense Precipitation Using FLO-2D*, Revision 0